

acidity of the upper parts of the canal favours, in health at least, the growth of the acid-forming bacteria, and may thus lead to an increased acidity and diminished decomposition in the lower parts of the canal.

5. Some antiseptic substances appear to act more on the first class of organisms than on the second. Thus salol seemed to act more energetically on the liquefying forms than on the acid-forming class, calomel the converse; while salol exerted a greater antiseptic power in the lower part of the intestinal canal, calomel in the upper portions.

6. Trypsin is capable of energetic proteolytic action in the presence of organic acids, but, as it is slowly destroyed by these acids, it has to be constantly supplied in fresh quantities.

7. The figures obtained for the total solids of the different sections show that absorption of fluids is greatest in the duodenum and lower ileum. The absorption from the large intestine can not be compared with the absorption from the other parts owing to the number of times its contents represented the material newly passed from the ileum.

“On a Discontinuous Variation occurring in *Biscutella laevigata*.”

By E. R. SAUNDERS, Lecturer of Newnham College, Cambridge. Communicated by W. BATESON, F.R.S. Received June 9,—Read June 17, 1897.

The observations recorded in this paper were made upon *Biscutella laevigata*, a cruciferous plant occurring as a perennial herb in the alpine and sub-alpine regions of middle and southern Europe. It was observed by Mr. Bateson that in a valley of the Italian Alps this species exhibits two distinct forms,* which exist side by side, the one hairy and the other glabrous. Plants showing various degrees of hairiness, and constituting a series of intermediate forms connecting the two extremes, were also found, but were comparatively scarce. As it may be presumed that in the state of nature the two varieties intercross freely, the question arises—how is their distinctness maintained? For on the supposition that hairiness and smoothness are characters capable of blending freely, it might be expected that offspring derived from a cross between hairy and smooth parents would tend constantly to regress to a mean condition of texture. It was in order to test the validity of this supposition, and to ascer-

* Mr. Bateson's attention was drawn to the variations of this species whilst staying in the Val Formazza, for the purpose of studying the alpine forms of the butterfly *Pieris napi*, for it is upon these plants that the variety *bryoniae* chiefly lays its eggs in this locality.

tain the facts of inheritance, as regards this particular character, that the following observations were undertaken.

Biscutella laevigata has a perennial rootstock bearing a crown of radical leaves.

The leaves are obovate, oblanceolate, or spatulate, tapering downwards to the petiole; the apex is obtuse, and the margin either entire or dentate-sinuate, with a water gland at each marginal tooth or lobe. The cotyledons are obovate, they scarcely taper, and the margins are invariably entire. In those plants in which the more elaborate type of leaf occurs, the first post-embryonic leaves are transitional between this and the simple entire form of the cotyledons.

In respect of flexibility, the leaves of different individuals show very considerable variations. In some plants (and this is more particularly the case with those which are glabrous) they are stiff and brittle and readily crack if the lamina is bent upon itself; in others this bending produces no lesion.

Far more striking, however, are the variations in the character of the leaf surface, which, as stated above, include intermediate gradations between leaves in which both the superficies and the margin are thickly covered throughout their whole extent with rather stiff hairs, and leaves in which the lamina is completely glabrous.

Upon referring to the descriptions of previous observers, I found that several agree in recording the variable character of the leaf surface; as regards the predominance of the different forms, their statements are, however, not altogether in accord.

Rouy and Foucaud* describe the leaves of *Biscutella laevigata* as rough and hirsute, rarely glabrous and smooth.

Parlatore,† in his simple unqualified statement that the leaves are glabrous or hispid, gives no hint that he regards the latter as the predominant and typical form; in a concluding note he adds that the variations in the degree of hairiness, as of other characters, form such a continuous series, that to consider them of taxonomic value in distinguishing varieties (unless almost infinite in number) would be entirely arbitrary.

Christ,‡ in contrasting the variety *saxatilis* with the type form (*i.e.*, *laevigata*), in like manner describes the latter as glabrous or pubescent.

Mertens and Koch§ deal with these variations in greater detail; according to them the leaves may be either thickly covered on both surfaces with rather stiff, spreading hairs, or they may be rough in

* 'Flore de France,' t. 2, p. 104.

† 'Flora Italiana,' vol. 9, p. 651.

‡ 'La Flore de la Suisse,' p. 121.

§ 'Deutschland's Flora,' vol. 4, p. 504.

consequence of tufts of stiff hairs borne on the leaf teeth, or the glabrous character may be even more pronounced, the leaves being destitute of hairs except for a few bristles on the petiole.

Reichenbach* and Boreau,† on the other hand, make no mention of a glabrous variety; the former describes the leaves as strigose hispid, the latter as pilose or hirsute.

The occurrence of glabrous and hairy varieties within the limits of a single species is not unknown; but in those cases previously investigated it has been found that this divergence of character can be correlated with some sensible inequality in the environment, and that where similar conditions constantly prevail there is uniformity of type. A familiar example of this kind of adaptation is afforded by the well authenticated case of *Polygonum amphibium* which was noticed by Linnæus;‡ this plant is invariably glabrous when growing in wet ditches or ponds, but it produces leaves more or less downy if for any cause the ponds or ditches dry up. By placing the land variety under appropriate conditions, Hildebrand§ was enabled to convert it into the typical aquatic form—a sufficient proof that both types are rightly referred to the same species. Nor is this the only instance that can be adduced; Linnæus|| observed a similar variability in *Plantago coronopus* and other plants; he also records that *Lilium Martagon* assumes a glabrous habit when cultivated in gardens, and that *Thymus serpyllum* becomes more or less hairy when growing on sea-coasts. It was further noticed by Moquin-Tandon¶ that plants occurring at high altitudes were generally more hairy than those found in the plains. More recently, a large number of comparative experiments have been undertaken by Bonnier,** who enumerates a list of species in which, among other changes, a greater or lesser increase in general hairiness resulted from transplantation from valleys to high mountain slopes. Again, Warming†† states that smooth plants occupying dry areas become hairy in moist situations, and, similarly, those which otherwise are somewhat hairy, under the latter conditions exhibit this character in a more marked degree; he quotes, in support of his statement, *Polygonum persicaria*, *Ranunculus bulbosus*, *Mentha arvensis*, and

* 'Flora Germanica Excursionis,' p. 660; also 'Icones Floræ Germanicæ,' in which the leaves are figured as hairy all over.

† 'Flore du Centre de la France,' t. 2, p. 56.

‡ 'Philosophia Botanica,' par. 272.

§ 'Bot. Zeit.,' 1870, p. 20; also Volken's 'Jahrb. des Königl. Botanischen Gartens zu Berlin,' vol. 3 (1884), p. 6.

|| *Loc. cit.*

¶ 'Pflanzen-Teratologie,' p. 62.

** 'Revue gén. de Bot.,' II, 1890; also 'Ann. des Sci. Nat.,' Sér. VII, t. 20, p. 225.

†† 'Lehrbuch der ökologischen Pflanzengeographie,' p. 187.

Stachys palustris. Vesque and Viet,* in a note to the same effect, also draw attention to an experiment made by Kraus upon the etiolated shoots of the potato, in which he found that those formed in the dark are glabrous when grown in damp air, and downy when the atmosphere is more or less dry.

In the case of *Biscutella levigata*, however, it seems impossible to explain the variations which occur as the result of a direct modification of habit to habitat—to conceive of them as due to differences in temperature, in illumination, in the humidity of the atmosphere, or in the nutritive capacity of the soil. For in all the instances quoted above, a certain constancy of form is associated with, and characteristic of, a particular environment; whereas in the species in question no such connexion is apparent, the two extreme types are not infrequently found in groups in close proximity to one another, or a hairy and a glabrous plant may even be growing in the same sod of turf, and presumably, therefore, under identical external conditions.

With the immediate cause of these variations, however, I am not here concerned further; whatever may be the active agent in their production, their occurrence suggested that a detailed study of these differences in the leaf surface might lead to interesting results bearing upon the views which have recently been brought forward with regard to discontinuous variation and its value as a factor in the origin of species.

Before entering upon an analysis of the experimental results it will be necessary to consider somewhat more in detail the variations in the degree of hairiness or smoothness exhibited by the leaf-surface. The following types may conveniently be distinguished:—

I. *Surface hairy.*—In the leaves of this class both the upper and the lower surfaces are thickly covered with hairs. In some individuals the hairy character of the leaf surface is easily recognisable at a glance; in others, in which the hairs are short, a closer inspection is necessary.

II. *Surface intermediate.*—To this type belong—

(a) Leaves in which a few stray hairs are scattered thinly over the upper surface.

(b) Leaves in which (more frequently) some portion of the upper surface is quite glabrous. This smooth area usually forms a longitudinal zone of varying breadth on either side of the midrib; the hairs, indeed, may be restricted to the margin and to a narrow belt of marginal surface. In rare cases the hairs are grouped differently: thus, the apical region may be hairy while the basal and middle portions are glabrous.

* 'Ann. des Sci. Nat.,' Sér. VI, t. 12, footnote to p. 174.

III. Surface glabrous.—This class includes—

- (a) Leaves in which the whole upper surface is glabrous, except, perhaps, for one or two hairs which, as it were, overflow from the continuously hairy margins at the level of the leaf-teeth.
- (b) Leaves in which both surfaces are glabrous, and, further, the marginal hairs are being confined to certain definite points—the leaf-teeth.
- (c) Leaves in which the lamina is wholly destitute of hairs.

[In types II and IIIa the under surface of the leaf was not examined, and the scattered hairs occasionally occurring on the midrib were also disregarded.]

Types I and II are so well marked that it is rare to find a leaf full grown, and with hairs on the surface, which cannot be referred with confidence to either category.

The flowering stem is hairy for a longer or shorter distance from the base in plants belonging to type I; whereas in those belonging to types II and III it is usually glabrous.

DETAILS OF EXPERIMENTS.

Ripe seeds collected from plants growing in the Val Formazza were divided into three sets, which were sown respectively in August, 1895, and in February and March, 1896; in addition to this material a few plants which survived transplantation from Italy, together with some specimens in the Cambridge Botanical Garden (which had been raised from seed supplied by M. Correvon, of Geneva), were also placed at my disposal. The seedlings were raised in pots under glass, and either planted out in the open in the spring, or repotted singly for greater convenience of manipulation. A careful examination of each leaf of the young plants brought to light a fact of considerable interest; it was noticed that in certain cases the first-formed leaves exactly resembled one another as regards the nature of the leaf surface, whereas in others the successive leaves exhibited degrees of hairiness varying more and more widely from the original type. In order to obtain a record of each leaf, it was found necessary to take special precautions to protect the plants as far as possible from the attacks of slugs and snails, to whom the leaves of this species seem to be especially palatable. The pots were therefore placed upon cinders, or surrounded with soot; if not thus protected many of the younger leaves would in a single night be reduced to bare midribs, or in the case of seedlings, the stump of the stem was often all that remained. The plants with smooth-surfaced leaves were more liable to attack than those that were hairy, although the latter did not wholly escape. In one batch of seedlings, which were all placed under the same

shelter, 107 leaves, belonging to 72 different plants, suffered more or less mutilation. Of these the leaf surface was glabrous in 94, intermediate in 5, and hairy in 5; in the remaining 3, so much of the leaf was devoured that its character could not be ascertained with certainty.*

It soon became evident that the individuals in which the uniform character of the leaves was maintained (not only in the seedling, but, as it proved, in the adult stage also) were those which as seedlings conformed to one or other of the extreme types, the leaves being either very hairy, or else destitute of hairs, except perhaps at the leaf-teeth. On the other hand, the plants exhibiting more than one grade of hairiness were those in which the first formed leaves corresponded to one of the types intermediate between these two extremes; among these latter the variations in different individuals were always along the same lines, and consisted in a gradual diminution in the number of hairs in successive leaves, until sooner or later a stationary point was reached, after which the character of the leaf surface usually remained constant.†

In enumerating the various grades of hairiness occurring in a single individual, I have intentionally disregarded the character of the cotyledons, for the reason that they do not appear to bear any constant relation (as regards texture) to the leaves which follow. In the case of a seedling in which as yet only the cotyledons were developed, I found it impossible to predict with certainty the character of the succeeding leaves. It is true that in nearly all hairy plants the cotyledons were also hairy, and that in many that were smooth the cotyledons were almost glabrous; but exceptions to this rule were not wanting, while in intermediates the cotyledons exhibited every gradation between the two extremes. Hence there was always an uncertainty as to whether hairy cotyledons indicated a hairy or an intermediate plant, and whether smooth cotyledons would be succeeded by glabrous or intermediate leaves. That this want of agreement between the cotyledons and the later leaves is a condition not peculiar to this species, but is one of common occurrence, needs no further proof than that furnished by a comparative study of the leaves and cotyledons of other members of the same natural order.‡

* The insufficient protection against such attacks afforded by the marginal tufts of hairs has already been noticed by Stahl ('Pflanzen und Schnecken,' Jena, 1888, p. 58).

† The stunted leaves which are sometimes formed at the beginning or the close of a period of vegetation, as, e.g., in late autumn or early spring, may prove exceptions to this rule; they are often distinctly less hairy than those of normal size borne on the same individuals. But when active growth once more sets in, the new leaves resemble the type previously established in those that developed normally.

‡ Lubbock, 'On Seedlings.'

The nature and extent of these individual variations will be seen on reference to Tables IV, V, and VI.

Exceptions to the foregoing statements are rare, yet now and again a plant may be found exhibiting an appearance strikingly suggestive of a bud variation. The development of accessory crowns of leaves, sometimes crowded together, sometimes borne on runners, is comparatively common, and as a rule the character of the leaves in such cases is uniform throughout the plant; but in these exceptional individuals the leaves of a secondary crown may differ widely from the original type. In one instance I found a plant bearing a crown of twenty leaves, with the hairs confined to the margin, which had produced a second cluster borne on a runner 3—4 inches long, and composed of eleven leaves, all with a very hairy surface. In another example, a young plant bearing a crown of seventeen leaves, belonging to intermediate types, developed another so close to the first that their leaves intermingled; those of the latter (four in number at the time of observation) were all very hairy.

A few other cases lend themselves less readily to so simple an explanation; in them the tendency to "sport" (if such it be) manifests itself not in a bud but in a single leaf. In such plants a leaf may appear showing a marked access of hairiness which is frequently asymmetrical; so that on one side of the midrib both the upper and under surfaces may be hairy, on the other the hairs may be confined to the margin; or again the hairs may be continuous along the margin of one side, and be entirely absent from the other; in these cases the succeeding leaves show a return to the normal symmetrical type.

Postponing for the present further reference to these exceptional cases, I pass on to a consideration of the results summarised in the following tables.

The total number of seedlings obtained from the three sowings was 280; seventy-two of these were not classified owing to the early death of the plant, or to the want of a continuous record of the leaf character, or in a few cases to the "mixed" character of the plant to which allusion has been made above. The distribution of types among the remaining 208 was as follows:—

Table I.

*Analysis of 208 Plants obtained from Seeds sown in August, 1895,
and March and April, 1896.*

	No. of plants.	Surface hairy.	Surface intermediate.	Surface smoo.h.
Sown in August, 1895	47	35	4	8
Sown in February, 1896	59	27	9	23
Sown in March, 1896	102	65	23	14
Totals	208	127	36	45

These numbers are not of value as indicating the relative proportion of the different types occurring in the particular locality from which the seeds were obtained; for in the first place a certain selection was intentionally employed in their collection, and secondly it happened that the majority of the seventy-two plants which were not included in Table I, for the reasons previously stated, belonged to types II (surface intermediate) and III (surface smooth), consequently the proportion of hairy individuals appears to be much larger than it actually was. As a matter of fact it is practically impossible to determine the numerical ratio of the different types in their natural habitat, owing to the characteristic habit previously mentioned of producing accessory crowns of leaves on runners or suckers, a habit which renders actual removal from the soil the only method by which it is possible to ascertain the limits of the "individual."

Of the 208 plants seventy-six were obtained from seeds gathered from two very hairy individuals (A and B); the character of the male parents was unknown, since these two plants like all the others from which seeds were collected had been naturally and therefore possibly promiscuously fertilised. The character of these seventy-six plants is shown in Table II.

Table II.

Analysis of 76 of the 208 Plants included in Table I, being the Offspring of two Hairy Plants, A and B.

	No. of Offspring.	Surface Hairy.	Surface Intermediate.	Surface Smooth.
Plant A	44	39	5	0
Plant B	32	22	8	2
Totals	76	61	13	2

A more detailed analysis of these 208 plants was made in the autumn of 1896, by which time the leaf character had apparently become constant in all those individuals which as seedlings had shown a tendency to assume a more glabrous habit; the results are recorded in the following tables:—

Table III.

Detailed Analysis of the 127 Plants bearing Leaves with a Hairy Surface.

Analysis.

Time of sowing.	No. of plants.	Plants dead or with leaves withered or too small for identification.	No. of plants unchanged.	No. of plants which had varied.
August....	35	11	22	2
February..	27	7	20	0
March	65	10	55	0
Totals ..	127	28	97	2

In one of the two individuals which had become smoother, both surfaces of the leaves were now glabrous, but there were numerous marginal hairs. In the other the change was much less pronounced; the under surface of the leaves was destitute of hairs except along the midrib, but the upper surface was hairy except for a very narrow strip bordering the midrib.

Table IV.

Detailed Analysis of the 36 Plants originally bearing Leaves with an Intermediate Surface.

Time of sowing.	No. of plants.	No. of which had varied.	No. of plants unchanged.	Type of earlier leaves.	Type of later leaves.
Aug.	4	..	2	Surface intermediate	Surface intermediate.
		2	..	„ „	„ smooth, hairs on margins.
Feb.	9	2	..	„ „	Surface smooth, hairs on margins.
		1	..	„ „	Surface smooth, hairs on margins or lobes.
		4	..	„ „	Surface smooth, hairs on lobes.
		1	..	„ „	Surface smooth, hairs on lobes, or smooth.
March	23	1	..	„ „	Quite smooth.
		2	..	„ „	Surface smooth, except for 1—2 hairs at the leaf-teeth; hairs on margins.
		8	..	„ „	Surface smooth, hairs on margins.
		5	..	„ „	Surface smooth, hairs on margins or lobes.
		4	..	„ „	Surface smooth, hairs on lobes.
		4	..	„ „	Quite smooth.
		—	—	—	—
Totals	36	34	2	—	—

Thus of the thirty-six plants originally bearing leaves with an intermediate surface only two remained unchanged.

These thirty-six plants included the survivors (thirteen) of those descendants of A and B which originally produced leaves with an intermediate surface; the variations occurring in them are shown in Table V.

Table V.

Detailed Analysis of the 13 Descendants of A and B, which originally bore Leaves with an Intermediate Surface.

Number of plants.	Type of earlier leaves.	Type of later leaves.
11	Surface intermediate.	Surface smooth, hairs on margins.
1	" "	" hairs on lobes or margins.
1	" "	" hairs on lobes.
—		
13		

Table VI.

Detailed Analysis of the 45 Plants bearing Leaves with a Smooth Surface.

Time of sowing.	Number of plants.	Type of earlier leaves.	Type of later leaves.
Aug.	1	Surface smooth, except for 1-2 hairs at the leaf-teeth; hairs on margins.	Surface smooth, hairs on margins (many).
	1	Do. do. do.	Surface smooth, hairs on margins (few).
	1	Do. do. do.	Surface smooth, hairs on margins or lobes.
	1	Do. do. do.	Surface smooth, hairs on lobes. Quite smooth.
	1	Surface smooth, hairs on margins.	" "
	1	" hairs on lobes.	Surface smooth, hairs on lobes.
	1	" " " "	" quite smooth. " "
	1	Surface smooth, except for 1-2 hairs at the leaf-teeth; hairs on margins.	Quite smooth.
	2	Surface smooth, hairs on margins.	Surface smooth, hairs on margins.
	3	" " " "	Surface smooth, hairs on lobes or margins.
Feb.	5	" " " "	Surface smooth, hairs on lobes.
	5	" " " "	" or quite smooth. " "
	5	" " " "	Quite smooth.
	2	" " hairs on lobes.	" "
	1	Surface smooth, except for 1-2 hairs at the leaf-teeth; hairs on margins.	Surface smooth, hairs on margins or lobes.
	7	Surface smooth, hairs on margins.	Surface smooth, hairs on lobes.
	2	" " " "	" or quite smooth. " "
	1	" " " "	Quite smooth.
	2	" " " "	Surface smooth, hairs on lobes.
	1	" " hairs on lobes.	" or quite smooth. " "
Total...	45		

From the observations summarised in the foregoing tables, it will be seen that the cases in which the whole number of leaves produced

by one individual exhibit a fairly uniform degree of hairiness (or smoothness) are almost invariably those belonging to the extreme types; the plants are either very hairy (type I) or almost glabrous (types IIIc and the smoother forms of IIId). All the plants in which the leaf surface was originally free from hairs remained smooth, while out of the total number of hairy plants only two varied from the original type. It is those in which the first formed leaves are intermediate in character between these two extremes that the change from a more to a less hairy condition may generally be traced (types II, IIIa, and the hairier forms of IIId). Consequently we find that the continuous series of gradations from the condition of absolute smoothness to that of extreme hairiness, which may be observed upon examination of the leaves of a large number of seedlings taken at random, is not met with in an equally large and haphazard collection of adult plants; among the latter certain forms have disappeared, and the types which obtain are more sharply marked off from one another. In fact adult plants fall into two groups; the type with leaves with an intermediate surface is not found, or occurs as a rare exception. It follows, therefore, that a census compiled from a set of adult plants, and a similar record obtained from the same individuals before the stationary point has been reached will not give concordant results; in the former case the proportion of plants bearing leaves with a glabrous surface will be higher than in the latter.

In order to ascertain the nature and amount of the variations occurring among the *offspring of unlike parents*, certain individuals which flowered in the summer of 1896 were intercrossed. The plants were placed under muslin covers in order to exclude insects, and the flowers were emasculated while still in bud before the anthers had dehisced, in order to prevent possible self-fertilisation. The seeds thus obtained were sown the same year after having been allowed to ripen for a few weeks; the character of the cross-bred seedlings is shown in Tables VII and VIII.

Table VII.

Classification of 120 Cross-bred Seedlings.

	Surface hairy.	Surface intermediate,	Surface smooth.	Totals.
Number of seedlings derived from five hairy plants × smooth (hairs wanting or confined to the lobes) plants.	4	7	26	37
Number of seedlings derived from five smooth (hairs wanting or confined to the lobes) plants × hairy plants.	5	32	28	65
Number of seedlings derived from one plant, surface smooth, marginal hairs numerous × hairy plant.	12	6	0	18
Totals	—	45	54	120

Table VIII.

Classification of the same 120 Cross-bred Seedlings arranged in Families.

Type of earlier leaves.	Offspring of five hairy plants fertilised by very smooth plants.					Offspring of five very smooth plants fertilised by hairy plants.					Offspring of one rather smooth plant fertilised by hairy plant.	
	Plant 1.	Plant 2.	Plant 3.	Plant 4.	Plant 5.	Plant 1.	Plant 2.	Plant 3.	Plant 4.	Plant 5.	Plant 6.	Plant 7.
Surface hairy	—	—	1	—	3	2	—	—	—	3	12	—
Surface intermediate.	1	3	1	1	1	12	—	6	8	6	6	—
Surface smooth, except for 1-2 hairs at the leaf teeth; hairs on margins	3	4	1	2	—	2	—	3	4	2	—	—
Surface smooth, hairs on margins	7	8	1	—	—	2	1	10	2	2	—	—
Surface smooth, hairs on lobes	—	—	—	—	—	—	—	—	—	—	—	—
Quite smooth	—	—	—	—	—	—	—	—	—	—	—	—
Totals	11	15	4	3	4	18	1	19	14	13	18	—

In all the "very smooth" plants used as parents in these experiments, the leaf-surface was quite smooth, and if marginal hairs were present they were confined to the leaf-teeth. In the "rather smooth" plant there were numerous hairs on the margins and leaf-teeth.

From the observations made upon this one generation of cross-breds, it would appear that when the extreme forms are intercrossed the offspring seldom exhibit the degree of hairiness characteristic of the more hairy parent; in most cases the first formed leaves corre-

spond to one of the glabrous or intermediate grades. In the one instance in which a plant not belonging to the extreme smooth type, but with numerous marginal hairs, was crossed with a hairy form, the general level of hairiness in the offspring was very considerably higher.

At the time of writing the character of the twenty-one hairy plants was unchanged. The fifty-four plants bearing leaves with a smooth surface were still smooth, and the number of marginal hairs was gradually becoming less. The remaining forty-five plants originally bearing leaves with an intermediate surface were all tending to become less hairy, in fact the leaf surface was free from hairs in all those which had apparently reached the stationary point.*

A few experiments were also made with the view of determining the character of the offspring in cases in which the parents *resembled one another in texture*. To this end certain individuals were placed under muslin covers, and either self-fertilised or crossed with others of the same type. Unfortunately none of the plants that were smooth set seed; four hairy individuals of the Genevese stock, however, fruited freely, and from them sixty plants were obtained, all of which showed the same degree of hairiness as the parents. It is of interest to compare these numbers with those obtained from the two hairy plants A and B (see Table II), which were freely exposed to insect visits; in the case of the latter only about 80 per cent. of the offspring belonged to the hairy type.

Although the results tabulated in the preceding pages have been obtained from observations upon a comparatively small number of plants, they are, I think, sufficiently concordant to justify the following conclusion. The experiments went to show that a blending of parental characters as regards hairiness and smoothness occurs to a certain extent in the offspring of plants of dissimilar types, giving rise to intermediate forms. But this intermediate condition in respect of hairiness is only found exceptionally among full-grown individuals. For whereas in plants which at first are *distinctly hairy*, the hairiness persists almost without exception, I have found that in nearly every case those plants which as young seedlings present an *intermediate* condition, assume, as they grow older, a more distinctly glabrous habit. This change of character in the cross-bred seedlings which are originally intermediate, takes place gradually; occasionally it does not occur until several leaves have been produced, but more often it is apparent as soon as the second and third leaves have developed.

* Though the seeds were all sown together, they germinated at such unequal intervals that the plants were at this time in very different stages of development.

HISTOLOGICAL NOTE.

A microscopical examination of the leaves revealed the presence of a histological feature of some interest. The general arrangement of the tissues follows the normal dorsiventral type ; it is the mesophyll, however, which claims especial attention, and exhibits a structural peculiarity which consists in the *thickening* and *lignification* of the *cell walls* in such a way as to form a latticed network. The mesophyll cells of the cylindrical leaves of some species of *Sansevieria* exhibit a somewhat similar appearance as has been previously recorded by De Bary,* and figured by Henfrey.† These bands of thickening give the characteristic lignin reaction with Schulze's solution and with phloroglucin. In all respects, save for this modification of the walls, these cells resemble the rest of the mesophyll, and judging from the amount of chlorophyll contained in them, their capacity for amylogenesis is not less than that of the unaltered cells. The number and distribution of these cells varies considerably in different cases, but so far as I have been able to ascertain, their occurrence is not correlated with any other structural feature. In order to determine their presence or absence in any given case, the leaves to be examined were allowed to rot in water until the epidermal layer could be easily peeled off with forceps from the under surface ; they were then mounted whole, with the under surface uppermost. When sufficient transparency could only be attained by decolorisation, the leaves were placed in alcohol, and afterwards boiled for a few minutes in water or in dilute HCl, to facilitate the removal of the epidermis. The method of examination by sections was found to give unreliable results, since the distribution of the cells is so erratic that their non-occurrence in a number of sections affords no certain criterion of their absence from the whole leaf. They may occur singly and remote from one another, or in groups in the meshes of the fibro-vascular network ; or continuous layers of the spongy mesophyll or of the palisade cells may undergo this modification ; in one case they may cover an uninterrupted area almost as large as the leaf surface, in another they may perhaps be confined to one side of the midrib, and be wholly wanting on the other, in fact, their distribution would appear to be entirely haphazard. In some cases they are present in the cotyledons, but more often they are absent from these organs, though they may be present in the later-formed leaves of the same plants ; their presence in one leaf does not necessarily imply their occurrence in other leaves of the same individual. To take a single instance—nine leaves belonging to a very hairy plant were examined ; in five of these the cells were abundant everywhere ; in two a few were present ; and

* 'Comparative Anatomy of Phanerogams and Ferns,' p. 118.

† 'Elementary Course of Botany,' p. 483 (2nd edition).

in the remaining two they were absent altogether. Besides those of *Biscutella laevigata* I examined the leaves of four other sub-species (?)—viz., *B. raphanifolia*, *B. ambigua*, *B. lyrata*, and *B. auriculata*, but I failed to discover any indication of lignification in the mesophyll of these plants.

Addendum, July 28, 1897.

Since the foregoing paper was communicated to the Society, I have myself visited the Val Formazza, and examined the character of the *Biscutella* plants in this locality, and also in one or two Swiss valleys. The results of these observations are given below :—

Val Formazza, from the head of the valley down to the Tosa Falls (5500 feet).

In this reach of the valley the plants are abundant everywhere—on the banks of shingle and sand and in the low-lying meadows near the stream, and on the grassy slopes of the surrounding heights, up to the Val Toggia on the one side, and as high as the lower limit of the Hohsand Glacier on the other. Both the hairy and the glabrous types were found, each variety often forming patches of varying size; such groups of dissimilar plants may occur side by side on exactly similar ground; or, on the other hand, a small area may be occupied by both forms, which are indiscriminately mixed together. On the whole the smooth individuals were more numerous than the hairy, especially in the low-lying meadows near the river, on the steep slope up to the Val Toggia, and on the slopes on the opposite side of the river between the châlets of Morasco and Riale. In the above-mentioned meadows intermediate plants were also found, especially the smoother forms, and though very few in number compared with the extreme types, they were more numerous here than in any other locality which I had the opportunity of observing. Many of these intermediates were apparently young plants, and their comparative abundance in this spot may, I think, be explained by the fact that the season was a late one, and that consequently some individuals were ranked as intermediates, which had not yet reached the stationary point, and which would eventually conform to the smooth type.

Val Formazza below the Falls and at Al Ponte (4200 feet).

Here the plants were much fewer in number than in the upper reach of the valley; immediately below the falls they were almost all smooth (no intermediates were seen); at Al Ponte the hairy and the glabrous types were found together on the shingle near the stream.

Val Bedretto (All' Acqua, 5265 feet).

The plants were exceedingly abundant in this part of the valley, both on the lower grass slopes and close to the stream; in both places the great majority belonged to the hairy type. Intermediates of the more hairy kind occurred here and there, generally in patches. The very smooth type was not common.

Val Canaria (Airolo, about 3900 feet).

Here the plants, which were only moderately abundant on the grass slopes, were all hairy.

Valley of the Rhone (at the foot of the glacier).

A few plants were growing on the shingle in the river bed, all very hairy.

Valley of the Rhone (Ulrichen, 4380 feet).

Only a very few plants were found, all very hairy.

Valley of the Rhone (Eggenen Thal).

Plants numerous, both glabrous and hairy occurring together; a few of the hairier forms of intermediates were also found.

Val d'Anniviers and neighbourhood of Berisal (Simplon).

According to Mr. Bateson's observations in the preceding year Biscutella plants were abundant in both these localities; in the former all the plants were very hairy, in the latter the hairy type predominated, but some hairy intermediates were also found.

"Studies in the Morphology of Spore-producing Members.

Part III. Marattiaceæ." By F. O. BOWER, Sc.D., F.R.S., Regius Professor of Botany in the University of Glasgow.

Received May 27,—Read June 17, 1897.

(Abstract.)

The memoir, of which this is an abstract, deals with the sori of all the four living genera of Marattiaceæ; the development has been traced in *Angiopteris* and *Marattia* from the earliest stages to maturity, in *Danæa* and *Kaulfussia* from such early condition as the material would permit. Some of the results from *Danæa* have been already submitted to the Society in a preliminary statement.* One result of the investigation has been to demonstrate, as regards their development, the substantial unity of type of the sporangia in the four genera. In all of them a single "superficial parent cell" of prismatic form is to be recognised embedded in the massive sporangium when young, not in a central position, but directed obliquely

* 'Roy. Soc. Proc.,' vol. 59, p. 141.